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ABSTRACT

This study investigates the influences and relationships between self-concept elements and students' activities in a normal school environment and focuses on individual self-construct. Interest has an important effect on an individual's learning process and behavior. There are three common definitions of interest: (1) interest as a characteristic of the person (individual interest); (2) interest as a characteristic of the learning environment (interestingness); and (3) interest as a psychological state. The investigation is based on a play-oriented teaching approach in an 8th grade gymnasium course. (Contains 21 references.) (YDS)

The Influence of Interest and Self-Concept on Students' Actions in Physics Lessons

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Introduction

In the past learning, especially in science instruction, was predominantly considered as a result, or process, of cognitive development. Variants such as the self-concept, motivation, self-esteem etc, were not assumed to be relevant

when learning processes were planned or analysed. Aspects of personality such as motivation had often been reduced to a kind of energy responsible for initiating student activities. On the other hand, motivation was seen to activate cognitive development but did not seem to have any significant influence on the result of the learning process.

Modern thinking on learning and development has been based heavily on cognitive psychology. Previous research on student cognition focused on demonstrating that prior conceptual knowledge influences all aspects of their information processing from their perception of the cues in the environment, to their selective attention, encoding and levels of processing information, and search for information. (Alexander PA, Schallert DL, & Hare VC 1991) The developed cognitive models are useful and relevant if learning is to be conceptualised. However, their reliance to a model of academic learning as cold and isolated cognition (Brown, Bransford, Ferrara & Campione, 1983) may not be applicable to describe learning in a classroom context. In recent years, theory and research on learning has shifted more or less from passive models of individual functioning to models that include individual goals and aspirations, the ability to develop and change strategies of actions, the knowledge about the self and the environment, etc (Krapp et al, 1992). Strike and Posner (1992) mentioned that Ña wider range of factors need to be taken into account when attempting to describe a learnersí conceptual ecology. Motives and goals and the institutional and social sources need to be considered." (Strike and Posner 1992).

Individual actions are based on cognitive processes (Pekrun, Helmke 1991). Self-related cognitive concepts and information are important for these actions. They influence individual actions, sometimes unconsciously, in different phases of the action process (Filipp 1979; Markus & Wurf 1987). The subjective belief in self-competence, for example, to cope with situations of great demand, is a main parameter of the type of student action in schools (Buff, 1991). Other investigations have shown that student self image, self-esteem, interests, self-confidence in their own ability, their relationship with science and former experiences with the subject, strongly influence their learning processes (Hannover, 1991, Hoffmann, 1997). But it has to be taken in mind, that nearly all of the results only came from questionnaires or at best from laboratory studies in a very special and restricted learning environments.

Our research interests was to investigate the influences from elements of the self-concept directly from student activities while they performed in a *normal school environment* . We therefore analysed their behaviour and activities in the classroom and identified the interactions of the so called working self-concept with students activities shaping their learning processes, whilst taking into account the constructivist position that the process of learning is influenced by personal, motivational and social processes.

The self-concept

The individual gains much from his or her socialisation, not only from their experiences within the social and materialistic surroundings, but from the acquisition of knowledge and information about themselves, through self-observation, interactions and social comparison. It is therefore probably vastly different from any description provided by an independent observer. Once internally developed the self-concept influences the perception, expectations and activities of the person.

Insert Fig. 1

The particular definition of self-concept we use in this investigation was based on the theory proposed by Markus and Wurf (1987). They developed a model of a dynamic self-concept (Figure 1). The self-concept is viewed as a collection of self-schemata, and the working self-concept is that subset of schemata which is accessible at a given moment. On the one hand, it depends on the social circumstances and the individual's motivational state as to which self-schemata are activated. On the other hand, the structures active in the working self-concept are the basis by which the individual initiates actions, and they are also the foundation for observation, judgement and evaluation of these actions.

The influence of the working self-concept can been seen in two broad classes of behaviour: (i) *intrapersonal* processes, which include self-relevant information processing, affect regulation, and motivational processes; and (ii) *interpersonal* processes, which include social perception, social comparison, and interactions with others. The outcome of one's *intrapersonal* and *interpersonal* behaviour determines the current motivational state and the salient social conditions for the next cycle of self-regulation. A divergence was made from the Markus & Wurf theory, the term self-schemata was not used to describe an element of the global self-concept. In reference to the critic by Hannover (1997) on the self-schemata concept used in this project, the term ëself-related cognitioní was used to describe the elements of the self-concept. Hannover (1997) mentioned that the schemata term is too broad and complex. An individual may not have a schema for several topics, but there is still probably some information relating to the individual, context and topic. In conclusion, a self-concept is a memory structure, in which all self-related cognitions are represented. For each individual context the cognitions are organised in clusters, called self-construction (Hannover 1997). The self-concept for different individuals differs not only in the available self-constructs, but also in the accessibility of these self-constructs. The more frequent a special self-construct is activated the better and more quickly it becomes accessible. The working self consists of a special selection of active self-constructs. Their configuration depends on the activation source. The stronger the accessibility of a particular self-construct the higher the probability of activation of this self-construct through a special activation source. The working self controls the processing of new information and individual behaviour. The self-concept also includes representations of ëpossible selvesí, which show the cognitive aspects of the individualsí aims, hopes and fears (Markus & Nurius, 1986).

It is obvious that it is almost impossible to investigate and observe all of the self-constructs of an individual. At the beginning of the project it was therefore necessary to concentrate our observations on only a few elements of self-construct. Researchers into ëinterestí (Krapp, Hidi, Renninger 1992) have mentioned that interest has a positive effect on learning processes. However, there has been little research carried out on interest and student cognition in science. Basic text reading was also investigated (Hidi 1992). Krapp (1992), also investigated interest and learning processes in the school environment, and supports the assumption that interest formulates a main part of the self-concept.

More especially the importance of a task seems to be related to the individualsí self-constructs. If a student sees him or herself as becoming a scientist - this scientist-concept can be seen as one of his or her possible selves (Markus, Nurius, 1996) - then scientific contents and tasks may be perceived as being more important, regardless of his or her mastery or performance during science learning. As a first step in this study we therefore decided to investigate interest as a part of the self-concept and the influence it has on student behaviour in the context of the classroom by identifying and analysing interest-oriented-actions.

Motivational states

If you are looking for interested students it is helpful to be acquainted with the range of motivations you may find in a classroom. During school lessons students normally experience a sort of strain between their own aims, interests and qualification wishes on the one hand and the demands of the teacher, the curriculum and the society on the other hand. A pedagogical theory of learning motivation should therefore model these different positions students can take in between these extremes. Basing on the self-determination theory of motivation of Deci and Ryan and on the pedagogical theory of interest of Krapp, Prenzel and Schiefele we can discriminate six states of learning motivation. Figure 2 shows them in a two-dimensional continuum of motivational states:

insert Fig 2

amotivated means states without directed learning motivation, indifferent up to apathetic, chaotic or helpless states.

extrinsic motivated learning means: the person is engaging only for getting announced confirmations or to avoid imminent disciplinary actions. Learning is determined by others and only resulting from external pressure.

introjected means, that the person has internalised the external reinforcement system. He or she engages in learning activities without direct pressure from outside, he or she forces him- or herself to the learning procedures, because otherwise he or she feels bad or Ñguilty".

identified means motivated learning of content or skills, that are not much attractive for the person, but he or she thinks, that it is important to have these competencies for reaching other self-determined aims.

intrinsic motivated learning starts from perceived attractions of the objects, content or activities. It is self-determined and can be detected by for example: curious questions, exploring activities or self-engaged problem solving.

interested means a more intense form of intrinsic motivated learning. Besides the attractions coming directly from the objects, the subjective value and the general importance of the object result in a variety of self-determined learning activities. Interested implies that the person wants to know more about the object and will engage with it further, not only in the actual situation.

The Concept of Interest

In general terms there are several definitions of the term 'interest' which are similar to the theory of the self-concept. However, there are two common attributes in all of these definitions. Interest relates to things, objects which are outside the person. Interest also designates personal preferences. Figure 2 illustrates three main lines of research into interest. They are (1) interest as a characteristic of the person (individual interest), (2) interest as a characteristic of the learning environment (interestingness), and (3) interest as a psychological state.

Insert Fig. 3

Both individual interest and interestingness can be the source for a psychological state in which an individual can be described as interested. Typical characteristics of this state might be positive feelings, increased attention and willingness to learn. Interestingness is the factor which can be arranged through the teacher during a lesson. How students cope with their individual interest and the interestingness of the situation was observed in our investigation. We wanted to clarify whether it was possible to distinguish between ênormalí student activity during the lesson and actions activated through interest. Krapp (1992) defined 'interest' as a special relationship between a person and an object (eg a theme or subject). This special person-object-relationship can be observed through an activity (an 'interest-oriented-action'), or through 'personal or individual interests' based on habitual structures. The interest-oriented-action is close to the current behaviour and action of the student; therefore it should be possible to identify these actions during physics lessons. The definition of an 'interest-oriented-action' as described by Krapp, contains three characteristics namely.

- *Cognitive Stabilisation* : The person has a great knowledge of the object and has an extensive repertoire of possible actions when he or she deals with the object. However, it is necessary for the person to gain more knowledge about the topic.
- *Emotional Status* : Interest-oriented-actions are always accompanied by positive, agreeable and stimulating feelings. These are feelings such as joy, agreeable tension, 'flow-experiences', competence, self-determination and social integration. Integration and acceptance are very important facts, especially when the individual acts within a group.
- *Personal Value of the persons' interest-action* : In the current interest-action the personal value component can be investigated through the 'self-intentionality' of the action the person is performing. It is possible to speak of an activity such as self-intentional when the person can plan and carry it out independently. The action does not need to be arranged by anybody else. The interest, the occupation and dealings with the object are important and valuable to the person. This finds its expression in a high position of the object or topic within the individualís value hierarchy.

Student interest-oriented-actions are the desired result from instruction in physics lessons. As researchers in physics education we are basically interested in how students learn and understands physics and how we can improve it. If we could describe the kind of instructional setting that leads to interest-oriented-actions, it would be possible to make demands on the quality of the instruction. Therefore one central aim of this investigation was to identify interest-oriented-actions. As described in the theory of the self-concept, actions, perception and expectations depend on the working self-concept. For that reason we cannot define student actions independently from their self-concept. It is necessary to see the student actions reflected in their self-concepts, even though different settings of the working-self-concept may be obvious.

Research Design and Methodology

The following sections show an example of our analytical and interpretative work in a condensed form. Also to explain our research methodology and demonstrate the kind of results we got from our investigation.

Classroom Setting / the Instructional unit

The investigation was based on a 20 week physics course, with an 8^{th} grade gymnasium class (approximately 14 years of age). The subject matter was on electricity, using a water analogy (Schwedes 1996). In several studies (Menge 1996, Dudeck 1997, Haeberlen 1999) this approach had been analysed under a cognitive perspective. We studied students learning difficulties, alternative conceptions and their learning outcomes and could formulate various learning pathways students had taken.

A main element of our teaching method was the **'play-oriented approachí** that was developed at the Institute of Physics Education, University of Bremen (Aufschnaiter, Schwedes 1989). Play-oriented, means the pupils work on self-elaborated questions, or independently, planned and carried out experiments based on their own ideas and hypotheses. Short teacher-oriented phases alternate with long action-oriented phases. This didactic concept hopefully gives students the opportunity, to engage in play-systems or interest-oriented-actions, which means nearly the same, as both are described by very similar characteristics by the play-theory of Helanko on the one hand and Krapps concept of interest on the other. Moreover play-oriented instruction was useful in following individual student actions and learning processes. The student actions were self-controlled, sometimes self-determined, and it was probably possible to identify their real interests or non-interests within the lessons or subject as a whole.

Data Collection

During the lessons video recordings documented the activities of 2 student groups and the personal interviews with the pupils. Elements of their self-concept had previously been determined through interviews and questionnaires. Sections were selected from the video recording for analysis. These scenes were subsequently transcribed, i.e. into linguistic and visible facial expressions, and physical actions were documented. The observer reconstructed student cognitive processes based on the observed actions and statements. For every action, observation, hypothesis or explanation the underlying idea was constructed.

When recording the interplay between elements of the self-concept and cognitive structures during the learning process it became obvious that more than just student task related actions could be observed and analysed. It was necessary to look in parallel at the related cognitive structures and development. The complex method of content based analysis, to describe a learning process, was developed in our Institute at Bremen University. The method cannot be explained in detailed here. More information can be found in a paper published by Welzel (1998). Our paper concentrates on the presentation of more detailed analysis of student actions observed during group work sequences and not on their cognitive development.

As already mentioned student actions and verbal comments were recorded during instruction and were analysed. This information was evaluated in relation to the previously mentioned characteristics of interest-oriented-actions. A short summary of important characteristics you can see at table 1.

Data Presentation

To demonstrate a more detailed outline of our analytical method we explicate the analysis of a sequence of tasks. For example, the 4th lesson of the unit ëwater and currentí is described. Three girls: Nadine, Corinna and Caroline, constitute a group on the physics course.

Presentation of the Students

As a result of the of the personal interview and questionnaire analysis a deeper understanding of the elements in the students self-construct was gained. This short summary introduces two students: Nadine and Corinna. We chose these two girls, as they worked in the same group, and because they had totally different levels of interest in physics. Nadine described herself as being very interested in physics and science. On the other hand, Corinna formulated, that she was not interested in physics or science. Both were good students. The following more detailed description provides an understanding of their actions and behaviour in this particular school lesson.

In summary we can state that Nadine possessed a positive physics self-construct. She enjoyed natural science and described herself as being talented in this area. In one interview she described how she repaired a vacuum cleaner step by step and how she helped her brother to install electrical wiring in their new house. Her career aspirations are to become a pilot. However, Nadine had a negative social self-construct. She felt that she was not accepted by the rest of the class and was consequently not very popular with her classmates. She described herself as shy and anxious. These illustrations are only a few of the characteristics that describe ëNadineí as a person.

In respect to her positive physics self-construct it would be reasonable to expect Nadine to be very active during a physics lesson, especially where a great deal of student experimental work was carried out. However, Nadine was mostly observed to be more passive than active, and more in the role of an assistant to her group members. Only in special situations Nadine did behave in the expected way: ie deeply involved in interest-oriented-actions. The reasons for her interest-oriented-actions and how they were accompanied by the activation of a different composition of the working self-concept were investigated.

Corinna did not have any interest in physics. She did not describe herself as unintelligent, but believed she was not talented in physics. In comparison with Nadine she possessed a negative physics self-construct. In her opinion, it was not necessary to be good at physics. ÑYou only have to be intelligent to understand a task in a physics lesson", she added ÑAnd I am not stupid." It was important for her to be a good student and therefore she was active in the lesson. She only wanted to find a solution to satisfy the teacherís request and to get a good remark, she was not interested in complicated questions. On the other hand, she had a very positive social self-construct. She was very popular and knew and liked her position in the class. She liked to communicate, act and to the centre of attention. Her career aspiration was to become an actress. The class selected her as a class spokeswoman.

Lesson Description

The lesson description is given only as a summary, as it would be difficult to understand what happened in a more detailed narrative transcript without viewing the video tape. For the more important sequences a translation of the transcript is included. To identify interest-oriented-actions we normally have to follow a sequence of learning activities, because time is needed to the development an interest-oriented action.

In the 4th lesson on ëWater and Currentí the students were asked to construct four distinct water circuits. (Figure 4). Each task contained questions centred around the observation of the double water column and the velocity of the flow watchers. In the previous lessons the students were introduced to the functioning of the materials used in this series of experiments.

The following description focuses on Nadine and Corinna:

After a short theoretical introduction summarising the results of the previous lesson the students started the *first experiment*. Nadine went to get the material for her group and a bucket of water to fill the double water column. When she returned to the table two other students were there and asked whether they could join the group. Corinna immediately agreed without asking the other group members. Nadine was not enthusiastic about this fact, but did not complain, and retired herself from the group. She stood aside and only watched the activities of the others. The two new girls worked on the first circuit (1) together with Carolin and Corinna. Corinna seemed not to notice that Nadine took no further part in the group activities. She behaved as she did in previous lessons. She was very active during the construction of the circuits and talks a great deal. Her comments mostly concerned her construction activities. The teacher came to the table and asked the two new girls to leave the table. They were told to carry out their own experiment because five group members were too many. The girls left and Nadine returned to the table. The circuit (figure 1) was ready. The students observed how the velocity of the flow watcher changed when the pump of the double water column was switched off. The students were asked to formulate a conditional statement Ñthe more ..the ..Ñ. Corinna turned to the blackboard and carefully read the task. She was not sure how they should carry out the first experiment, especially as to what they should observe. She switched off the double water column as was mentioned in the task. She then formulated her observation.

NA: What shall we do now?

CA: We should watch what happens now.

CO: The flow watcher is rotating ... and column A lowers until column B is filled up to the same level ...

NA: Yes, but the flow watcher rotates slower and slower

CO: That depends on how you put it ... in which position (takes the flow watcher and *changes the position on the table)*

NA: No ... leave it where it is. ... The more the water level is balanced, the slower the flow watcher is rotating.

Corinna turned to the neighbouring table and started talking. In her opinion the task was done. Nadine and Caroline started to discuss how the observation should be written up. Corinna turned back to her group and formulated the sentence again, which had already been stated by Nadine. The teacher came to the table and discussed the observations with the students. Nadine did not take part in this discussion. It was Corinna who responded and answered the teacher's questions on the behaviour of the flow watcher. The teacher confirmed the observations. Nadine had followed the discussion attentively and confirmed her observations of the relationship between the different water levels in the double water column and the velocity of the flow watcher. She was the first out of her group who noticed the relationship during the experiment.

Corinna started the construction of the *second water circuit* (2 **).** Nadine now became more involved in the construction. Right at the beginning she wanted to modify and improve the setting by including a tap instead of a clamp. Nadine tried to explain to her group that a tap and clamp serve the same function. In addition, the tap was easier to both install and handle. However, the circuit was constructed with the clamp. Corinna insisted on the clamp because it would be more fun and it was mentioned in the task. The students started up the circuit. They planned to close the tube by screwing up the clamp because they were asked to describe their observation when removing the clamp, but the instructions made no sense to them. Corinna was occupied with fixing the clamp and switched the double water column on and off. Nadine called the teacher for help. After discussing the experiment, for example, when the pump should be switched on and off, the students carried out the experiment and discussed their observations. The teacher returned to the table and gave advice on carefully observing the heights of the water levels in the double water column and to listen to the sound of the pump. (In the case of a shortcut, the water level difference slowed down, the pump worked to its maximum level [permanently], but could not maintain the original water level difference. When the clamp was nearly closed, the pump started acting only from time to time - to re-establish the original water level difference thus pumping back the water flown through the circuit.) Nadine was more active during this discussion with the teacher. After the teacher had left the table the students discussed their observations again, especially what Caroline should write down. Caroline started to record in her book the observations they had made. Corinna was sure the observations Caroline had noted were correct and also wrote them down. Nadine disagreed. She started to discuss the result of the experiment again with Corinna. During this talk Corinna maintained that the pump of the double water column had to work harder when the clamp was closed. Nadine repeated the experiment again. This time however, she used the tab instead of the clamp.

CO: when you close and not when you open.. the pump has to work ... because there is so

much water dammed up

NA: we will repeat it ... but without that stupid clamp

She switched on the double water column. She closed the tap carefully and observed the water levels in the two columns of the double water column. Her observation differed from the results maintained by Corinna. She tried to convince her classmate, but with no success. Nadine still had doubts but could not give a reasonable argument to change Corinnaís mind and so finished the discussion with the words: Ñ*we will see later when we discuss the observation with the whole class.*Ñ

The 3 students started to build *the 3 rd water circuit* . A series circuit with 3 flow watchers. 2 of them could be short cut by opening a tap. So the circuit could be varied from a circuit which included only one flow watcher to a circuit with 2 or 3 flow watchers. Nadine was quite active during the construction of this circuit and gave orders to her group members: *(to CO)..Ñ there you have to use a very short tubeÑ* and so she controlled the construction process and several times compared the developing water circuit on the table with the diagram displayed on the overhead.

CA: What are you doing Nadine? ... we have already 2 flow watchers

NA: Yes ... but we need 3 flow watchers. ... we have to check the circuit first before we

start the real experiment

Corinna and Carolin worked on the setting up of the circuit, but Corinna especially talked a great deal (private talk included) which was normal for her during the construction of circuits. Nadine was much quieter when working. They started to put the circuit into operation. The first task was to have only one flow watcher in the circle. The 3 girls were not sure how they could prevent the other 2 flow watchers from entering the circle. They constructed the circuit correctly including the 2 taps, which could be used to short-cut 2 flow watchers. However, they did not see this particular function of the taps. It was Nadine again who asked and discussed the problem of how they could carry out the experiment. Corinna answered her questions but referred to the written task and used the written text. Nadine carefully inspected the circuit and constructed the right idea concerning the function of the taps. The third student Caroline did not take part in this discussion. She was occupied with removing the air bubbles from the tubes. Nadine then closed and opened the taps.

> *NA: we should start with only one rotating flow watcher ... but I donít know how we should realise this*

CO: yes ... how should we vary the circuit.

NA: exactly

CO: (read the task again) ... open and close ... okay we should close two first

NA: yes but if we

CO: only that one should be in series ... it can only be this flow watcher

(shows the flow watcher without a short-cut)

CA: (removes the air bubbles out of the tubes)

NA: if we close this tap now (closes the first tap)

CA: no , leave it open, we must first remove the air bubbles

NA: yes ... now this one circles alone

CO: yes, but this one is still turning (points to the flow watcher with

no short-cut) ... we must stop, close this one

CA: (is still occupied with the air bubbles)

NA: this might have something to do with this branch here

CO: but we built it exactly like the circuit-diagram

CO: perhaps we didnít have enough swatters (points to the taps) ... ...no we have two

CA: so, all air bubbles must be out of the tubes

CO: okay, what shall we do now

CA: we could ask the teacher.

Nadine, in a suddenly state of excitement, tipped her head with her hand. She had discovered the function of the taps. She showed her discovery to her group.

NA: good heavens ... if this tap is open, the flow watcher doesnít turn ... because the

water prefers this tube where there isnít a flow watcher .... if we close this tap

then the flow watcher must circle (she closes the tap) ... look

CO: (looks at the flow watchers) now 2 are circling ...

but we need only one that circles

NA: only one ... sure (she opens the second tap and both flow watchers

are short-cut)

CO: yes okay we will do it like this (turns to the blackboard and reads)...

we should observe the velocity.... (turns back to the table and looks at her watch)

The students repeated the experiment and later discussed their observations on the velocity of the flow watchers with their teacher. The more flow watchers in a series circuit the slower the velocity. However, they recorded them all with the same velocity. Nadine was very active in this discussion. She also made sure that the observation, *her* observation, was noted carefully.

Corinna was not really involved in the problem solving. She started to feel bored. In the end she even looked at her watch to check how many minutes remained before the end of the lesson. Nadine had become more deeply involved in the experiment and tried to determine the real function of the circuit. But at that moment Corinna seemed to be no longer interested in the experiment. She did not feel any joy or excitement, as Nadine did, even though she understand the function of the circuit.

In the discussion with the teacher when she came to the table Corinna took part but not as in previous discussions. Nadine was more active. Caroline wrote down the observations. Nadine did the dictating. Corinna asked the others to sing with her. She started to sing sometimes while the group were constructing the circuits. Often when she felt bored. She tried to have fun and therefore tried to model the situation so that her needs could be fulfilled. In the end comments were made which really demonstrated that she was looking forward to the end of the lesson.

The 4 th circuit was a parallel circuit including 2 flow watchers. Again the velocity of the flow watchers was to be observed. Nadine started to build the circuit alone. Corinna preferred to talk privately with students from the neighbouring tables. Caroline was occupied with writing the task into her notebook. But after finishing she joins Nadineís to help her construct the circuit. Corinna returned to the table and watched the activities of the others. When the circuit was finished Nadine carefully inspected the construction. She opened and closed the taps and observed the velocity of the flow watchers. Corinna also watched how the flow watchers circled. However, her observations were not correct. Nadine corrected them.

CO: I thought that the two flow watchers would circle slower.

NA: no that is not right ... if they are parallel they have the same velocity

CO: ..if you close this tap (closes the tap) ... the flow watcher is slower

Na: No, this is not true ... both have the same velocity ...

The teacher came to the table and confirmed Nadineís observations. She asked some questions concerning the experiment, eg how much water was running through different parts of the circuit. Nadine mainly answered these questions. Corinna and Caroline did not participate in this discussion. They started to arrange their things so that they could leave the classroom immediately when the bell rang.

Data interpretation

The following data interpretation is a summary of the results received from a detailed analysis of the verbal and non-verbal student interactions.

Nadine

Nadine carried out an interest-oriented-action, which started during the construction of the 3 rd circuit. She experienced a cognitive challenge when trying to find a solution to task 3 and realised a remarkable gain in competence when she found the solution (short-cutting two flow-watchers so that only one, instead of three were circling). This cognitive stabilisation was (a) accompanied by a positive emotional situation, (b). Nadine was involved in the group activities, she felt accepted, the others agreed with her explanations and plans, and she could follow her ideas, which were accompanied by feelings of self-determination. She was satisfied with her solution, she was right and enjoyed feeling competent. The personal value, (c) lay in the possibility of doing physics her way, which meant self-intentionality in the activities of scene 3. The positive energy which came with the success in scene 3 inspired Nadine to organise the task in scene 4, so here too she was involved in an interest-oriented action. She led the group through the experiment and all of the characteristics mentioned in scene 3 could also be identified here. In scenes 1 and 2 Nadine was task-oriented but did not perform an interest-oriented action. Her social situation did not allow her too many positive feelings. In the first scene she felt excluded from the group's communication process and excluded herself instead of trying to integrate. The negative social self-construct was dominant in the working self. She showed her physics competence but Corinna dominated the group and the talks with the teacher. Nadine tried to fit her ideas to the activities of the group and not to be excluded, so there was no self-intentionality in her actions. In the second scene Nadine tried to realise her ideas (using a tube) so elements of the physics self-construct were active at that moment. She wanted to solve the task in an easier way, but Corinna would not accept it. So Nadine withdrew from the group activities again, but did not lose her task orientation. She asked the teacher for help in order to carry out the task correctly, after they had failed to find a solution during their group discussions. This was not important to Corinna, but Nadine wanted to understand what she had done and learn how to carry out the experiment correctly. During this part of the lesson a change from a dominant negative social-self-concept (one of the reasons for her passivity), to a dominant positive physics self-concept was observed (Figure 4).

Corinna

At the moment when Nadine engaged in an interest-oriented action, Corinna finished hers. She looked forward to the end of the lesson, she began singing and talked to other girls. Her working self was dominated by social self-constructs. Corinna lost her interest in the water circuits because she could not find interesting questions to guide her observations and did not see the relevance of finding rules or solving cognitive physics problems. She was dependent on the instructions of the task and follows them willingly. She discussed the observations of the group with the teacher and was eager to know the right answers and write down the results, but this was motivated by the wish to be a good student.

In scene one and two Corinna was engaged in interest oriented actions. Her interest resulted from the interestingness of the situation, from the experimental materials on the one hand, and from the possibility of private and task-oriented communication on the other. She enjoyed the manual activity whilst constructing the water circuits, she felt competence at being able to construct the circuits as indicated in the diagrams (b). Her cognitive stabilisation (a) lay in the lower level, although intellectually she had no difficulties in understanding the implications drawn from the experiments. She felt stimulated and slightly thrilled (b), also because the water circuit was probably open somewhere so that water ran out making everything wet. There were communication activities that were funny. The construction activities allowed her to also talk, chat, laugh and sing (b). She developed a broad variety in her modes of communication and improved them steadily (a). She felt satisfied at being the centre of a communicating group and being its representative when talking to the teacher (b). Communication held a high value for Corinna (c) and her communication activities were self-intentional, because she could choose her partner and the subject of discussion: Corinna was engaged in an interest oriented action. When the group work became more physics based task work, she diverted her interest and activities to other issues, such as talking to the neighbouring table, or writing down the results. She did not become engaged in problem solving. She just wanted to do something, but when a question was not too clear it became of no importance to her. She would ask the teacher or just wait until the results were presented to the class. That was sufficient for her. She did not feel the need to find the result for herself.

Caroline

In the scene described Caroline has a minor part. She seems to engage in an interest-oriented action in cause of the interestingness of the situation, liking to construct watercircuits and make them running. She is the one, who removes the airbubbles and is watching that no water will be spilled. She cares for the social integration of the group, she reintegrates Nadine, when she stands aside and appreciates Nadines contributions to the groupwork explicitely. She does what has to be done and doesnít complain when she clears away things the others have left. She is the one who writes down the description and the results of the experiments as well as the answers to the problems to be solved or the rules, which were to be developed. Corinna and Nadine often dictate, what Caroline should write, but then copy from her. Caroline follows the instruction of the teacher, seldom introduces own ideas but regularly proves her understanding of the phenomena, normally when writing down results or explanations. Her motivational status doesn't change very much and is normally found on the level "identified".

Conclusion

This article began with a brief review of the major theoretical features of the correlation between motivation, learning, self concept, interests and studentsí actions. Based on the theory of Krapp we demonstrated that it was possible to identify interest-oriented-actions from classroom observations. We concentrated on presenting interest as an element of the self-concept. In terms of the other information concerning the self-concept we obtained from interviews and questionnaires, we were able to analyse and distinguish between other active self-constructs in the working self. It was also possible to show the different compositions of the working self in a number of situations. In the case of Nadine, a dramatic change was recorded from a dominant negative social self-concept to a dominant positive physics self-concept. This change could explain the unexpected behaviour of Nadine, i. e. that she got involved in the physics activities only after a long period of reservation although she is interested in physics activities.

A lack of special interest in physics in the case of Corinna seemed not to prevent her from demonstrating interest-oriented-actions. Her interest actions were activated through the interestingness of the environment. If frequent interest-oriented actions lead to an increased interest in physics as a personal disposition, or as a new element of the self-concept is an open question. This will be pursued in further research. We also continue our investigations with the intention of observing a difference in the learning processes dependant on the activation source of an interested-oriented action: personal interest or interestingness.

As it is predicted in the theory of Helanko, we can see the change from a non play system to a play system, especially for Nadine in the presented example, but also for the other students in other sequences of the unit of instruction. Every individual is permanently inclined to transform non-play systems into play systems, i.e. to transmit given external objectives and processes to personal objectives and actions by the way of identification and modification. But (meaningful) learning predominantly takes place in play systems, or whenever non-play systems are transformed into play systems. It is worthwhile to notice that the three girls form a well working social group and that one of the factors that support the development of interest-oriented actions is the possibility of being involved in a variety of social interactions between the group members.

In the process of socialisation Helanco says play systems are disturbed by the demands of other persons (parents, teacher, ..) or institutions (school, church). These disturbances or interfering systems play an important role in the studentís development, because they initiate the building up of new and more differentiated systems. Only the continuous change between play systems and non-play systems support the process of socialisation and learning but he assumes that learning is much more effective in play systems and the knowledge acquired has a deeper and more netlike structure as compared with the normal learning processes in school.

With our given example we can underline this in so far, as it is the cognitive challenge, that engages Nadine in the course of solving problem 3, and it is the success of her idea, that supports the following interest-oriented-action.

Learning Styles

The Learning styles of the three girls are very different, but this seems to have no effect on their achievement in physics knowledge, as intended by the teacher. They all arrive at a high level of understanding and belong to the top students of the class.

Caroline is mainly learning by writing. In making the protocolls for the group, she is overthinking the arguments and explanations and is controlling herself, and had understood them. She seldom discusses in the group or defends her ideas. Corinna on the contrary is mainly learning from discussion, in formulating her understanding or insights, she gets feed back, especially from the teacher. When she was wrong she accepts the right answer without problems, beleiving in the authority of the teacher. She freely uses all information she gets, especially the results from Nadine and presents them as the group result, presenting herself as competent at the same time.

Nadine is learning from experimenting and problem solving. She needs a cognitive challenge to really get involved. When she notices, that she had made a mistake, she is looking where she had drawn a wrong conclusion or what was her mistake exactly. Only when she is convinced, she follows the explanations of the teacher. She is looking for consistency in her cognitive arguments and often noticed that the explanation they found in the group didnít fit with the observations they made in the experiment. Nadine feels herself as a physics expert, and she is puzzled when she failed. This affects her physics self-concept and she retires from activities for some time till she has recovered or found the cause for her error.

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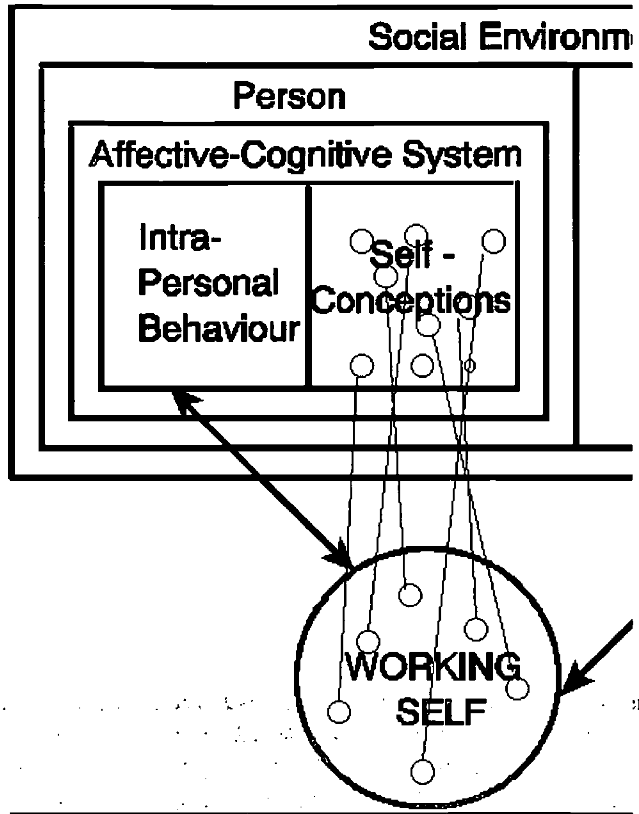
Table 1

Indication for analysis of behaviour related to interest-oriented-actions

(extract)

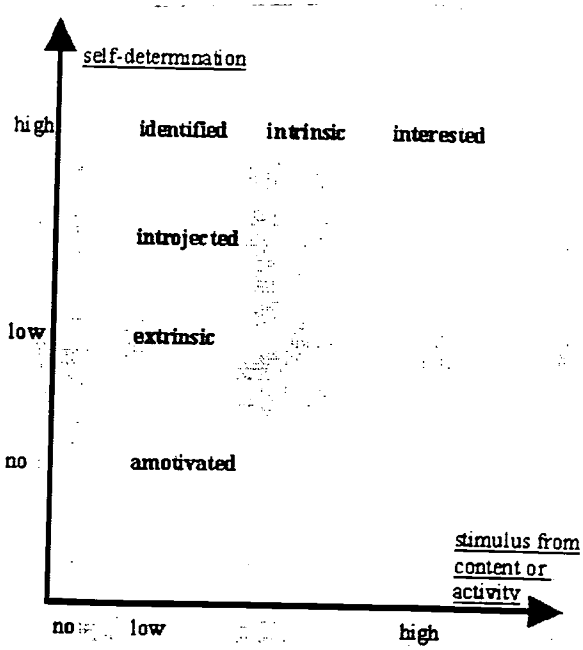
verbal	non-verbal
◻ most statements consider the task and topic ◻ statements express joy ◻ statements concern the importance of the task and actions ◻ statements which shows deeper enquire ◻ problem solving ◻ statements which shows that the individual wants to know more	◻ absolute concentration on the task and topic ◻ only action and behaviour which is necessary for the task and has a relation to the task ◻ no reaction to disruption ◻ variation of the task

Fig. 1



Markus H. :rspective;

Fig. 2



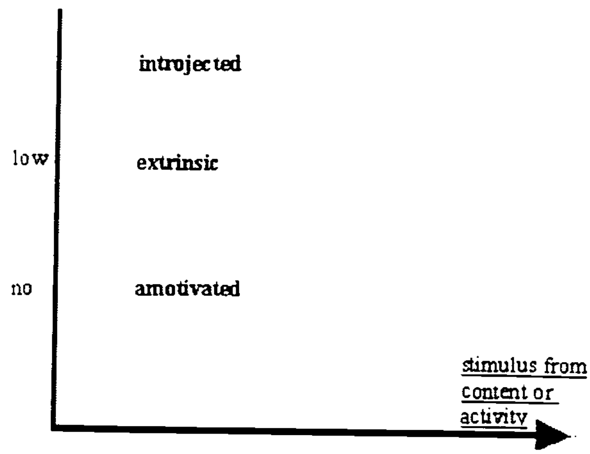
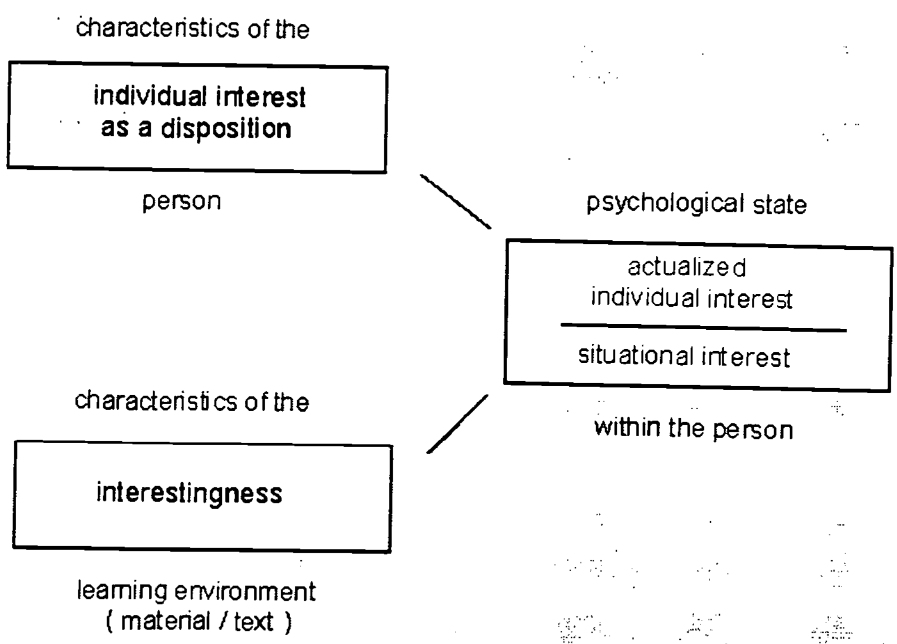


Fig. 3



The Concept of Interest

Krapp A., Hidi S., Renninger K.: Interest, Learning and Development; In: The Role of interest in learning and development, edited by K.A. Renninger, 1992

learning environment
(material / text)

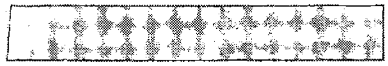


Fig. 4

look at special file named "bildpaper"

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